Upper Bound On Io's Heat Flow

Dennis L. Matson, Torrence V. Johnson, Glenn J. Veeder, Diana L. Blaney,
and Ashley G. Davies

Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109

Analysis of the temperatures and areas of Io's observed thermal anomalies yields an upper bound on Io's total heat flow. We find a distribution function that allows an assessment of the heat flow from undetected, cooler anomalies, and predicts a limiting temperature of about 90-95 K. This temperature is in agreement with measured *Voyager* IRIS and *Galileo* PPR nighttime minimum temperatures. Furthermore, our limiting temperature provides a logical explanation for these otherwise puzzling nighttime data. Our methodology explains the value of the "minimum temperatures" as well as their lack of dependence on both latitude and time-of-night. As a result of this, we conclude (with few possible exceptions, e.g., high mountains) that Io is covered completely by lava in various stages of cooling. Integration of the thermal emission along our distribution function all the way up to the surface area of Io itself yields the first upper bound for heat flow, 13.5 W m^{-2}, which corresponds to a total global, radiated power of 5.6×10^{14} W. This work was carried out at JPL/Caltech under contract to NASA.